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Effect of Planting Media Composition and Consentration of Vegetable Waste Liquid Organic Fertilizer on the Growth of Oil Palm Seedlings (*Elaeis Guineensis Jacq*) in the Main Nursery

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ABSTRACT: The research was carried out at Research and Educational Garden of the STIPER Agricultural Institute which is located in Maguwoharjo, Sleman, Yogyakarta Special Region, Indonesia. This experiment was conducted from April – July 2023. This research design used a factorial experiment arranged in a completely randomized design (CRD) consisting of two factors. The first factor was the composition of the planting medium with 3 kinds, namely: M1 = top soil + cocopeat (1:1); M2 = top soil + husk charcoal (1:1) and M3 = top soil + cocopeat + husk charcoal (1:1:1). The second factor was the LOF of vegetable waste which consists of 4 kinds, namely: P0 = without LOF (Liquid Organic Fertilizer) of vegetable waste (control); P1 = 50 ml / plant; P2 = 80 ml /plant and P3 = 100 ml / plant. The treatment combinations were 3 x 4 = 12 with 4 replications to obtain 48 plants. Data observations were analyzed by using analysis of variance (ANOVA) and if there were significantly differences, it was continued analyzed with the Duncan's Multiple Range Test at 5%. There is an interaction between the composition of the planting medium and the LOF of vegetable waste, on the fresh weight of the crown and the fresh weight of the roots. The best treatment combination for crown fresh weight and root fresh weight is top soil + husk charcoal with vegetable waste LOF 100 ml/plant. The composition of the planting media has an influence on planting height, number of leaves, fresh weight of the crown and fresh weight of the roots. Top soil + charcoal husk planting media is the best. The LOF concentration of vegetable waste has an effect on stem diameter, fresh weight of the crown and the roots. Giving vegetable waste LOF of 50 ml/plant and so on up to 100 ml/plant shows better growth.

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KEYWORDS: Main nursery, organic fertilizer, combination media . oil palm seedling

1. INTRODUCTION

Seedling is the stage of oil palm (*Elaeis guineensis* J) cultivation after obtaining planting material in the form of oil palm sprouts. The seedling stage will determine plant growth in the field. One thing that determines this is the planting medium used. The composition of the planting media can be made so that the media can provide sufficient nutrients and water for plants.

Several types of materials that can be used as planting media include top soil, husk charcoal, cocopeat and many others. Each of these organic materials has benefits and advantages so that they can be used in efforts to improve the quality of seedling (Mulyani *et al*., 2018).

Cocopeat, which made from coconut fiber, is an alternative planting medium that can be used to cultivate various types of plants. Cocopeat has the property of easily absorbing and storing water (Kuntardina *et al*., 2022). Cocopeat has a good level of aeration so it easily absorbs nutrients and oxygen (Atikah *et al*., 2023).

Burnt husk charcoal is one of the organic waste materials that can be used as a planting medium because burnt husk charcoal can maintain moisture. Burnt husk charcoal is a porous and sterile planting medium made from rice husks which can only be used for one growing season. The advantage of burning husk charcoal is that it can improve the physical and chemical properties of the soil, and can protect plants (Aryani *et al.,* 2021).

Apart from using good planting media to get high quality oil palm seeding is by fertilizing. Liquid organic fertilizer (LOF) is a fertilizer material that can be used in maintaining oil palm seedlings. The ingredients for making LOF can come from various

organic materials. On the other hand, in everyday life we find by-products of human activities in the form of waste. Vegetable waste is the most common waste from human activities and is an important problem in maintaining environmental cleanliness. Utilizing vegetable waste as material for making LOF is an activity that can simultaneously overcome problems that exist in the human environment (Gunawan *et al*., 2022).

2. MATERIALS AND METHODS

Place and Time of research. This research was carried out at Stiper Agricultural Institute Educational and Research Garden at Maguwoharjo, Sleman, Yogyakarta Special Region, Indonesia. Research was conducted from April - July 2023.

Tools and materials. The tools used in this research were: hoe, machete, bucket, watering basket, spade, soil sieve, wood, bamboo, ruler, stationery, polybags, digital scale and oven. The materials used in this research were: LOF vegetable waste, burnt husks, cocopeat, top soil , 3 month old oil palm seedlings.

Research design. This research design was used a factorial experiment arranged in a Completely Randomized Design (CRD) consisting of two factors. The first factor is the composition of the planting medium with 3 levels, consist of : M1 = top soil + cocopeat (1:1), M2 = top soil + husk charcoal (1:1), and M3 = top soil + cocopeat + husk charcoal (1:1 :1). The second factor was vegetable waste LOF which consists of 4 levels, namely: P0 = no vegetable waste LOF (control), P1 = 50 ml / plant, P2 = 80 ml/ plant, and P3 = 100 ml/plant. The number of treatment combinations were 3 x 4 = 12 with 4 replications to obtain 48 plants.

Preparation of planting medium. The soil used was topsoil, then sieved to make it into fine granules and the soil was clean of rubbish or wild plant remains. Then the sifted soil was put into a polybag. There were several compositions that need to be carried out according to the treatment, namely top soil and cocopeat in a ratio of 1: 1, top soil and husk charcoal in a 1: 1 ratio and top soil, cocopeat and husk charcoal in a ratio of 1: 1: 1 combined in a volume to medium ratio planting that was evenly composed.

Making vegetable waste LOF. The process of making liquid organic fertilizer was carried out anaerobically. The materials needed to make vegetable waste LOF were water, EM4, vegetable waste and brown sugar. The steps in creating a LOF were: 1) Cut/chop organic vegetable waste materials that could be used as raw materials. It was put in a barrel and added water, the composition was: 3 parts organic vegetable waste, 1 part brown sugar, and 10 parts water. 2) EM4 and brown sugar was dissolved in water then added the solution to the barrel containing organic waste vegetable materials that have been cut into pieces. The LOF was closed tightly and left it for 1.5 months.

3. RESULTS AND DISCUSSION

Observation data were analyzed by using analysis of variance (ANOVA), if the ANOVA analysis showed significantly different, then a further test was carried out using Duncan's Multiple Range Test (DMRT) with a confidence level of 95%.

The results of variance analysis show that there is a significantly interaction between the composition of the planting media and concentration the LOF of vegetable waste on the fresh weight of the crown and the fresh weight of the roots. This means that these two factors work together to provide good for crown fresh weight and root fresh weight for the growth of oil palm seedlings in the main nursery.

Table 1. Effect of planting media composition and LOF of vegetable waste on crown fresh weight and root fresh weight.

Growing media	LOF vegetable waste	Observation parameters	
		Fresh weight of crown (g)	fresh weight of roots (g)
Top soil + cocopeat (1:1)	Control	30.84cd	13.08e
	50 ml/plant	36.03bcd	19.58bcd
	80 ml/plant	27.78d	17.95bcd
	100 ml/plant	39.63abc	17.23cde
top soil + husk charcoal (1:1)	Control	33.88bcd	18.61bcd
	50 ml/plant	44.07ab	16.56cde
	80 ml/plant	39.03abc	20.83abc
	100 ml/plant	46.76a	25.11a
top soil + cocopeat + + husk charcoal (1:1:1)	Control	36.79abcd	15.03de
	50 ml/plant	30.29cd	19.33bcd
	80 ml/plant	41.80ab	16.82cde
	100 ml/plant	37.49abcd	22.42ab

Note: The average number followed by the same letter in the column indicates there is no significant difference based on DMRT at the 5% level.

Table 1 shows that the combination of top soil + husk charcoal with vegetable waste LOF of 100 ml/plant has the best effect on crown fresh weight. It can be that planting media with added husk charcoal can improve the physical properties of the planting media so that it can maintain soil moisture, because if husk charcoal is added to the soil it will be able to bind water and increase the organic content in the planting media, then it will be released into the soil pores to be absorbed by plants and encourage the growth of oil palm canopy. These results are in accordance with the opinion of Ainiah *et al*., (2019) that rice husk charcoal media contains a lot of organic material, can absorb water, has large pores and can accelerate plant growth. Lestari *et al., (2015)* stated that the nitrogen nutrient (N) in LOF stimulates plant growth, because nitrogen forms amino acids into protein. The proteins formed are used to form plant growth hormones. This is what makes the combination of top soil + husk charcoal with LOF vegetable waste 100ml/plant is the best.

The root fresh weight in Table 1 shows that the combination of top soil + husk charcoal with 100 ml vegetable waste LOF/plant gives the best effect. It is predicted that the microorganisms and nutrients contained in vegetable waste LOF can help the development of plant roots. This result is in accordance with the opinion of Tengku *et al.,* (2021) that when microbes grow well around the root cap, the plant, through root function, will be able to absorb the available nutrients optimally. The amount of nitrogen absorbed will also increase. Nutrient absorption will be more optimal if it is supported by good rooting and a good number of active roots. According to Irawan & Kafiar, (2015) the use of organic husk charcoal material is thought to have crumb properties so that air, water, nutrients and roots easily enter the soil fraction and can bind water. This is very important for the roots of plant because the growing medium is closely related to root growth or the characteristics of plant roots.

It is thought that adding organic material to the planting media and providing vegetable waste LOF can work together to improve the quality of the planting media, where the microorganisms in the vegetable waste LOF can help fertilize the planting media and help compost the organic material in the planting media. This is in accordance with the opinion of Saragih *et al*., (2019) the organic material in the planting media will be broken down by microorganisms so that in this case a high population of microorganisms also requires plant nutrients for plants and their reproduction. According to Gunawan *et al*., (2021) the cell microorganisms found in the process of making LOF are microorganisms that produce cellulose enzymes which will speed up the composting process of organic materials.

Table 2. Effect of plant media composition on the growth of main nursery oil palm seedlings.

Observation Parameters	Growing media		
	Top soil + cocopeat	Top soil + husk charcoal	Top soil + cocopeat + husk charcoal
Plant Height Growth (cm)	10.22b	13.95a	12.68a
Number of leaves (pieces)	7.44b	8.06a	7.81ab
Bar diameter (mm)	20.18a	20.06a	21.04a
fresh weight of crown (g)	33.57b	40.94a	36.59ab
crown dry weight (g)	9.84a	12.37a	10.87a
Root fresh weight (g)	16.96b	20.28a	18.4ab
root dry weight (g)	6.25a	7.21a	6.39a
root length (cm)	43.63a	48.63a	49.13a

Note: The average number followed by the same letter in the column indicates there is no significant difference based on DMRT at the 5% level.

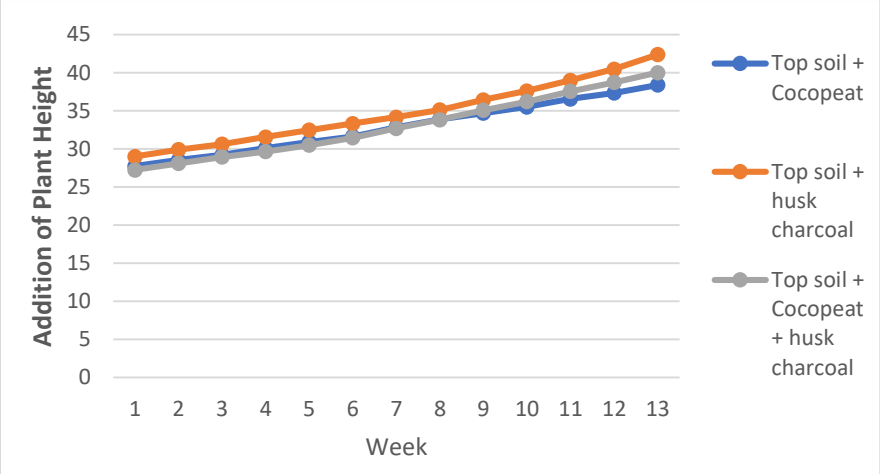

Figure 1. Height growth of main nursery oil palm seedlings on the application of planting media composition on weeks.

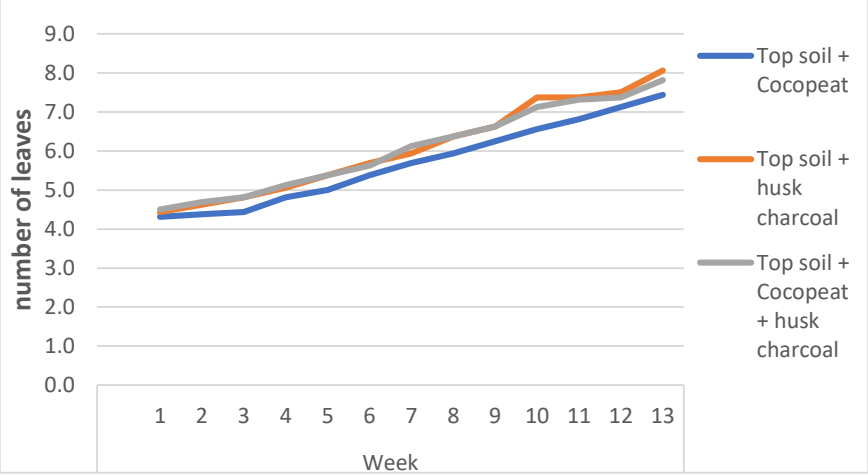

Figure 2. Growth in the number of leaves of main nurse oil palm seedlings on the application of planting media composition.

In Table 2, the treatment of planting media composition had a significantly influence on the growth parameters of planting height, number of leaves, fresh weight of the crown and fresh weight of the roots. In the four parameters above, the best planting media composition was in the top soil + charcoal husk treatment. It is predicted that the planting medium with added husk charcoal contains the nutrient N. The nutrient contained is a macro nutrient where the N element is used by plants for plant growth, especially in the vegetative phase, especially in the formation of chlorophyll, amino acids, fats and enzymes. The availability of nitrogen contained in husk charcoal is necessary for the formation or vegetative growth of plants such as leaves, crowns and roots. These results are in accordance with the opinion of Agustin *et al*., (2014) The availability of the elements N, P, and K greatly influences the photosynthesis process. The elements N, P, and K are essential elements that have an important role for plants. The results of nutrient content analysis show that the planting media added with rice husk charcoal has a higher percentage of N elements. According to Ginandjar *et al*., (2019) husk charcoal can provide porosity in soil pore spaces which can be occupied by water and air. According to Koyama *et al*., (2016) the SiO_2 content in charcoal husks uptake of silicon by plants increases photosynthesis by suppressing excessive transpiration and improving the light interception structure in growing plants.

It can be that the addition of organic material to the planting medium can act as an adhesive between soil particles to become soil aggregates, so that organic material is important in its formation and the addition of organic material can increase the population of soil microorganisms. This is in accordance with the opinion of Panda *et al*., (2021) that adding organic material to the planting medium can improve soil structure, increase the ability to store water, and act as an energy source for microorganisms in the planting medium. The function of organic matter is to improve soil structure, increase temperature in the soil, increase aggregate stability, increase the ability to store water, and reduce soil sensitivity to erosion, as well as a source of energy for microorganisms in the soil. In table 2, the treatment of planting media composition has a significant influence on the parameters of planting height, number of leaves, fresh weight of the shoot and fresh weight of the roots. The treatment with top soil + cocopeat planting media composition obtained the lowest growth. According to Asroh *et al*., (2020) planting media mixed with cocopeat has micro pores which are able to absorb greater water movement, resulting in higher water availability. At certain times, these conditions cause gas exchange in

the media to experience obstacles because the media is saturated with water. This happens because the macro pore space which should be filled with air is also filled with water so that the roots experience obstacles in breathing. Therefore, the air in the planting medium will decrease, which can inhibit plant growth. According to Irawan & Kafiar, (2015) there is tannin contained in coconut fiber powder, tannin is a mechanical barrier compound in the absorption of nutrients.

The results of observing the growth rate of seedling height when applying the composition of the planting media to oil palm seedlings in the main nursery are presented in Figure 1 and the growth in the number of leaves is presented in Figure 2. Observations were carried out for 13 weeks with measurements every week starting from the 1st week. The height growth rate of oil palm seedlings in the main nursery is as follows.

Table 3. Effect of vegetable waste LOF on growth parameters of oil palm seedlings in the main nursery.

Observation Parameters	LOF vegetable waste			
	control	50 ml/plant	) ml/plant	100 ml/plant
Plant Height Growth (cm)	10.99p	11.94p	12.58p	13.62p
Number of leaves (pieces)	7.50p	7.83p	7.83p	7.92p
Bar diameter (mm)	18.83q	20.96p	21.14p	20.77p
fresh weight of crown (g)	33.84q	36.8pq	36.21pq	41.29p
crown dry weight (g)	9.59p	11.26p	11.04p	12.22p
Root fresh weight (g)	15.57r	18.49q	18.53q	21.59p
root dry weight (g)	5.43p	6.49p	6.93p	7.62p
root length (cm)	44.33p	47.92p	46.83p	49.42p

Note: The average number followed by the same letter in the column indicates there is no significant difference based on DMRT at the 5% level.

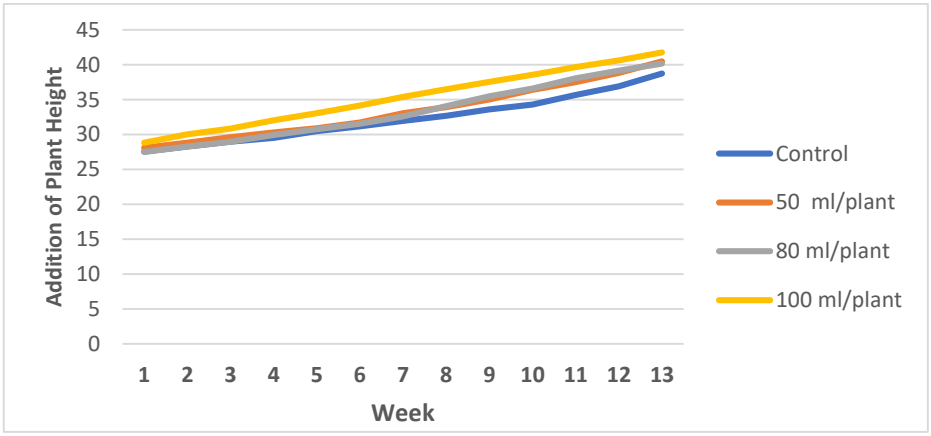

Figure 3. Height growth of main nursery oil palm seedlings using vegetable waste LOF application.

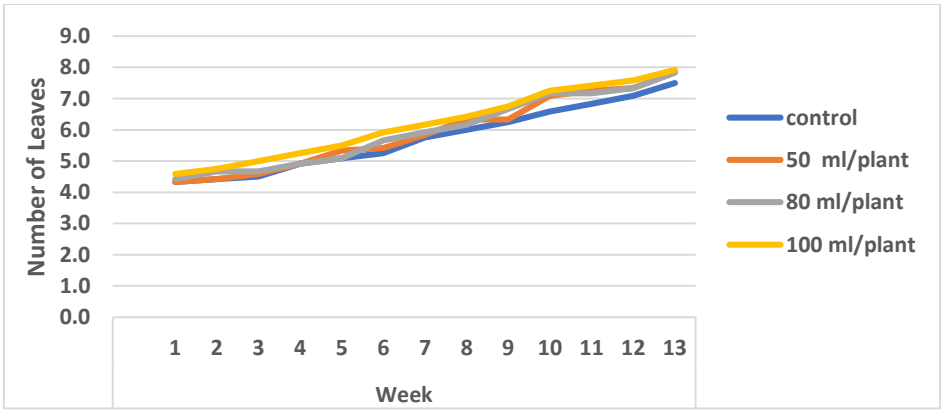

Figure 4. Growth in the number of leaves of main nursery oil palm seedlings on the application of LOF vegetable waste.

Based on Table 3, giving LOF vegetable waste has a significantly influence on the stem diameter, fresh weight of the shoot and fresh weight of the roots. Giving vegetable waste LOF of 50 ml/plant and then up to 100 ml/plant shows better growth compared to treatment without vegetable waste LOF (control). It is predicted that the ability of liquid organic fertilizer can be easily absorbed by plants. According to Santosa *et al*., (2023) the ability of liquid organic fertilizer to provide adequate macro and micro nutrients, especially nutrients such as nitrogen (N), phosphorus (P), and potassium (K), also supports plant growth. The content of these nutrients, especially N, P, and K, is very important because they act as essential elements and as components of protein and chlorophyll, which have a vital role in increasing plant growth.

Apart from providing macro and micro nutrients, liquid organic fertilizer also has microorganisms that can help improve the physical properties of the soil. According Gunawan *et al*., (2021) organic fertilizer made from environmental products that contain various beneficial microorganisms that can improve and maintain soil fertility, in addition, can suppress the growth of disease bacteria so that the stems, roots and leaves of plants can grow well. Muthu *et al*., (2023) that organic liquid fertilizer provides important nutrients for plants and microorganisms that help decompose organic matter. According to Arliani *et al*., (2023) the nitrogen contained in liquid organic fertilizer can improve the growth of the apical meristem.

The results of observing the growth rate of seedling height following the application of POC vegetable waste to oil palm seedlings in the main nursery are presented in Figure 3 and the growth in number of leaves in Figure 4. Observations were carried out for 13 weeks with measurements every week starting from the 1st week. The height growth rate of oil palm seedlings in the main nursery is as follows.

4. CONCLUSION

1. There is an interaction between the composition of the planting medium and concentration of the LOF of vegetable waste, on the fresh weight of the crown and roots. The best treatment combination is top soil + husk charcoal with vegetable waste LOF 100ml/plant.
2. The composition of the planting media has an effect on plant height, number of leaves, fresh weight of the crown and roots. Top soil + charcoal husk planting media is the best.
3. The LOF of vegetable waste concentration affects the parameters of stem diameter, crown fresh weight and root fresh weight. Giving vegetable waste LOF 50 ml/plant and so on until 100 ml/plant shows good growth.

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